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SOME COMMONLY NEGLECTED FACTORS UNDERLYING THE STOCK BREEDING INDUSTRY

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BULLETIN 258.

SOME COMMONLY NEGLECTED FACTORS UNDERLYING THE STOCK BREEDING INDUSTRY.[1]

By RAYMOND PEARL.

THE BREEDING INDUSTRY.

Animal-breeding as an industry lies at the foundation of animal husbandry, which in turn is a basic element of the art of agriculture. Before any of the domestic animals can be used to provide food or clothing for mankind, the animals themselves must be produced. It is the function of the art or craft of animal-breeding to *produce* the world's supply of domestic animals of all kinds.

An attribute of living organisms, which fundamentally differentiates them from non-living matter, is the faculty of self-reproduction. Certain cells of the body in all higher animals are able, under suitable conditions, to go through a process of development which has as its end result the production of a new individual of the race or species. Through these cells (known as reproductive cells, or gametes) the animal has the power of reproducing itself. A new and distinct individual existence is brought into the world. Nothing like this is known in the inorganic realm. The stone in the field is not capable, through any self-initiated or self-perpetuated activity, of causing the coming into existence of a new stone, essentially like itself in form, size, structure, chemical composition and every other quality. Only plants and animals—in other words, living things—can do this.

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[1]Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 107.

The substance of this paper was presented as an address before the Maine Live Stock Breeders' Association at its meeting in Augusta, December 5, 1916. The introductory portion is a reprint, with some slight changes and corrections of typographical errors, of a paper entitled "The Animal-Breeding Industry," published in the Scientific Monthly, July, 1916, pp. 23-30.

It is this fundamental attribute of self-reproduction which the art of animal-breeding makes use of for the benefit of mankind. The breeder attempts to direct and control the reproduction of certain species and varieties of animals which possess qualities that are of value. Thus the breeder of dairy cattle endeavors so to control and direct the reproduction of these animals that he shall be able to produce cows which will yield a large amount of milk. The beef-cattle breeder tries to produce animals which carry on their frames a large amount of meat of good edible quality. The sheep-breeder has for his object to bring about the plentiful reproduction of animals bearing a large amount of wool. And so on, always the breeder is trying to control, guide and direct a fundamental biological process (reproduction) in such way that the product may be most valuable to him in some direction, either utilitarian, æsthetic or other. The more complete this control is, and the more definitely it is directed towards a particular desired end, the greater is the success of the breeder.

Man's needs or fancies have led to the production of many and diverse breeds of the domestic animals. In every civilized country special breeds and sub-breeds or varieties have been developed to meet the particular conditions prevailing there. In the number of such specialized and diversified races of animals, all of which must have come originally from a very small number of unspecialized ancestral forms, is perhaps to be found the most striking measure of the degree to which man has developed and extended his control over the natural processes of reproduction. Some idea of the extent to which this differentiation and specialization of animals for particular ends has been carried may be gained from Table I. This table shows the number of different breeds and varieties of farm live stock which are found in the British Isles.[2] Some are local varieties, but still distinct. All these are essentially native British breeds. Other countries, especially the older ones, show in greater or less degree the same conditions. They have developed breeds of live stock to suit their own special needs and fancies.

[2]This table is compiled from " British Breeds of Live Stock," London (Board of Agriculture and Fisheries), 1910.

TABLE I.

Showing the Numbers of Different Breeds of British Live Stock.

Kind of Stock	Number of Distinct British Breeds and Varieties
Horses	17
Beef cattle	13
Dairy cattle	7 [3]
Sheep	34
Swine	8

It is evident from this table that the skill of the English breeder has well justified the reputation it has created for the British Isles as one of the chief sources of the pure-bred live stock of the world.

To produce the world's supply of domestic animals, which we have seen to be the business of the animal breeder, is a task of great magnitude. Resort must be had to statistics[4] if any just conception is to be formed of the extent and importance of this breeding industry. We shall confine our attention to the United States, remembering that except in certain rather restricted lines, the animal-breeding industry in this country has as yet had no special or intensive development.

The following table shows the number of living domestic animals of various kinds which were on farms in the United States on January 1, 1912, together with their estimated farm value. The figures take no account of the vast numbers of horses, for example, which are not on farms.

[3] Counting the Dairy Shorthorn as a distinct variety.

[4] The raw data on which the following statistical discussion is based are taken from the official returns of the U. S. Department of Agriculture, as published in the Yearbooks. The writer is, of course, responsible for the treatment of these figures here developed and for the deductions made.

The fact that the statistics here used are three years old in no wise invalidates the conclusions. Essentially the same conclusions would be reached from a survey of the stock-breeding industry in any normal year. Of course just at the present time industrial conditions of all sorts, including stock-breeding, are upset by war conditions. On that account, indeed, it is altogether probable that the facts as here presented give a much more nearly normal picture of the industry than would statistics for the years 1914 or 1915.

TABLE II.

Number and Value of Farm Live Stock in the United States on January 1, 1912.

Kind of Stock	Number	Value
Horses	20,509,000	$2,172,694,000
Mules	4,362,000	544,359,000
Milch cattle	20,699,000	815,414,000
Other cattle (chiefly beef)	37,260,000	790,064,000
Sheep	52,362,000	181,170,000
Swine	65,412,000	523,328,000
Total	200,602,000	$5,027,029,000

Each one of these two hundred million animals was produced by a definite breeding operation. Somewhere somebody, with more or less care and thought as to the result, mated together two animals to produce each one of the individuals or litters which lumped together give this enormous total. The mere statement of such large figures conveys little impression to the mind. Let us try by comparison to see what the figures really mean. If all the live stock on farms in the United States on January 1, 1912, had been sold at a price such as to realize the estimated farm value in cash, and then the money so obtained had been equally divided, each individual man, woman and child in the country would have received as his share from this transaction $54.66. Furthermore the farm value of live stock represented an amount sufficient to pay the whole principal of the public debt of the United States (equal to $2,906,750,-548.66 on October 1, 1913) nearly twice over.

This same sum of money would support the common schools of the United States for more than 12 years, assuming the same rate of school expenses as obtained in 1908-09. The mules or the swine each alone, if converted into cash, would pay all the common school expenses for more than a year, the cattle for four years, and the horses more than five years. The sheep of the country on January 1, 1912, were worth more than one and a half times as much as the entire property (lands, buildings, equipment, etc.) of all the colleges of agriculture and mechanic arts in the United States in 1910, the last year for which figures were available when this was written.

The figures given do not tell the whole story of the magnitude of the animal-breeding industry of the country. They deal only with the live stock actually on the farm. Besides this are the exports to be reckoned with. Table III gives the facts regarding exports.

TABLE III.

Number and Value of Live Stock Exported from the United States During the Year Ending June 30, 1911.

Kind of Stock	Number	Value
Horses	25,145	$3,845,253
Mules	6,585	1,070,051
Cattle	150,100	13,163,920
Sheep	121,491	636,272
Swine	8,551	74,032
Total	311,872	$18,789,528

Over against the exports are to be set the imports. Animals are imported into the United States for purposes falling into two general classes. On the one hand, are the imports, mainly from European countries, of superior animals to be used as breeding stock. The ultimate object of such importation is the improvement of the live-stock of the country. On the other hand, there are some importations of animals for purposes of slaughter and utilization in other ways than breeding. The live-stock imports of each of these classes for the fiscal year 1910-11 are given in Table IV.

TABLE IV.

Number and Value of Live Stock Imported into the United States During the Year Ending June 30, 1911.

Kind of Stock.	Why Imported.	Number.	Value.
Horses	For breeding purposes	6,331	$2,055,418
"	" other "	3,262	636,656
Cattle	" breeding "	2,441	362,220
"	" other "	180,482	2,590,857
Sheep	" breeding "	5,341	116,277
"	" other "	48,114	261,348
Total		245,971	$6,022,776

From the figures given in the preceding tables it is possible to make some calculations to show average individual values. These are of interest because they furnish some indications of the cash value which rewards attention and care devoted to the breeding of animals. Let us first consider the average values of the different kinds of live stock on the farm. These figures will furnish a base with which comparisons may be made. They measure in a crude way, but still a real one, the stage of development or progress which the live stock breeding industry of the country has attained. Table V gives the figures, calculated from the data given in Table II above.

TABLE V.

Average Values of Live Stock on the Farm.

Kind of Stock	Average Value of the Individual
Horses	$105.94
Mules	124.80
Milch cows	39.39
Other cattle	21.20
Sheep	3.47
Swine	8.00

It is to be expected that animals chosen for export will be on the average of somewhat better quality than those left on the farm. A part go out of the country for breeding purposes, and these will have a powerful effect in raising the average value of exported stock. In accordance with expectation, the average values for exported stock are seen in Table VI to be in every case somewhat greater than those for farm stock. The relative amount of this increase, shown as the percentage which the difference in values is of the farm value, is given for each class of stock in a third column of the table.

TABLE VI.

Average Values of Live Stock Exported.

Kind of Stock	Average Value of Individual	Percentage Increase in Average Value of Exported Over Farm Live Stock
Horses	$152.92	44.3
Mules	162.50	30.2
Cattle	87.70	216.7[5]
Sheep	5.24	51.4
Swine	8.66	8.2

While the relative increases of value seen here are respectable, considered by themselves, they are insignificant in comparison with those exhibited in the valuation of animals *imported* for breeding purposes. The figures for the latter are shown in Table VII, which is calculated in the same way as Table VI.

TABLE VII.

Average Values of Live Stock Imported for Breeding Purposes.

Kind of Stock	Average Value of Individual	Percentage Increase in Average Value of Imported Over Farm Live Stock
Horses	$324.66	206.5
Cattle	148.39	435.8
Sheep	21.77	529.2

Taking these figures at their face value, for the moment, they indicate that the average horse imported into the United States for breeding purposes is worth three times as much as the average horse on an American farm. The average cow or bull imported is worth nearly five times as much as the average cow or bull on the farm; while the average imported sheep is more than six and a quarter times as valuable as the home product on the farm.

These figures furnish an impressive object lesson as to the value of paying attention to the breeding of live stock. Fundamentally the enhanced valuation of the imported animals rests on the fact that they are better bred than the

[5]Calculated on the basis of weighted mean of the two classes of cattle distinguished in Table V.

average farm stock here. Their qualities all approach the ideal more closely. But they have been brought to that condition by the practice of skilful, well-planned and carefully executed breeding.

The statistical data so far presented regarding the breeding industry have been drawn from official returns and cover the country as a whole. They suffer from the defects of such statistics. While they show the general relations in a substantially correct way, they tend to reduce to a minimum differences of all kinds. In the case of the last comparison made, the indicated difference in average valuation between farm and live stock and that imported for breeding purposes *is probably distinctly less than the true difference.* A better comparison, and one which not only shows what careful breeding means to the farmer and to the nation as a source of wealth, but also shows that the foreigner has no monopoly on the production of fine breeding stock, is between average farm values and the prices realized at auction dispersal sales of pedigreed stock in this country. Let us examine a few figures of this kind.

Table VIII[6] gives the average sale price of pedigreed beef cattle in all sales held in this country during the six years preceding 1913.

The increase of these prices over the $21.00 of the farm cattle is obvious. The same considerations apply to other kinds of stock. At a Guernsey cattle sale held in Oconomowoc, Wisconsin, March 20, 1912, 69 head were sold at an average price of $377.26. Mr. H. E. Browning of Hersman, Ill., sold 41 Duroc-Jersey swine " of his own breeding " on December 19, 1912, at an average price of $173 per head. The contrast of this price with the $8.00 average on the farm is sufficiently striking.

The live-stock breeding industry of the world rests on a foundation of pure-bred pedigreed stock. The constant aim of the breeder from the earliest time has been to produce differentiated types particularly adapted to his locality, conditions and needs. Having once found or developed such a type, the breeder wishes to keep it. This he can only

[6]Compiled by the Breeders' Gazette and published in the issue of January 1, 1913.

Table VIII.

Average Prices Realized at Auction Sales of Pedigreed Beef Cattle.

Name of Breed.	1912.			1911.			1910.		
	No. of sales.	No sold.	Average price.	No. of sales.	No. sold.	Average price.	No. of sales.	No. sold.	Average price.
Short-horn	45	1,882	$177 40	53	2,258	$162 50	49	1,999	$187 50
Hereford	15	957	180 40	19	1,203	160 50	20	1,214	146 20
Aberdeen-Angus	12	627	138 95	13	723	143 60	19	995	167 35
Galloway							1	67	83 30
Polled Durham	2	83	132 85	1	42	140 60	3	74	115 00
Red Poll	1	30	107 25				1	41	185 00

Name of Breed.	1909.			1908			1907.		
	No. of sales.	No. sold.	Average price.	No. of sales.	No. sold.	Average price.	No. of sales.	No. sold.	Average price.
Short-horn	78	3,308	$159 00	59	2,689	$146 50	84	3,608	$160 15
Hereford	25	1,398	127 05	15	936	116 15	29	1,358	123 70
Aberdeen-Angus	18	935	189 00	18	955	165 10	18	1,119	134 75
Galloway	2	69	128 05	3	136	84 50	3	123	139 05
Polled Durham	2	79	129 45	6	244	124 50	3	106	130 35
Red Poll	3	35	97 80	1	3	50 00	3	97	83 00

do if it " breeds true." It obviously could not be expected to breed true if at frequent intervals it were crossed with other types. The breeding of individuals all of the same general type, and belonging to a few family lines, could be safely left to the individual breeder in the earlier days of the industry. With the wider development of the industry this was no longer possible. It became necessary to have an official registration of pedigrees, which should be beyond any chance of manipulation by the breeder. In this way one wishing to purchase an animal of a particular breed would have definite and objective evidence that the individual was, in fact, of the breed it was supposed to be.

Out of this need have grown the systems of pedigree registration in herd-books, stud-books and the like. In most countries at the present time these registry records have an enhanced official status, because they are under governmental control and supervision. In the United States the control of live-stock registration is in some degree supervised by the Bureau of Animal Industry of

the federal Department of Agriculture, particularly so far as concerns the registration of imported animals.

The statistical data given in the foregoing discussion are by no means complete, but they serve sufficiently well the present purpose, which is simply to give some conception of the magnitude of the live stock breeding industry and its importance as a source of wealth to the nation. No account has been taken of other than farm live stock, and such obviously represents only a part of the animals which somebody has to breed to supply the needs of the people. Further, nothing has been said about poultry, which represents an important industry in itself. Altogether, however, the following statement by Heape,[8] in concluding a review of the value of the breeding industry in England, is as well justified by conditions in this country, as in the country for which it was written. He says:

> All I have attempted is, to give such a broad idea of the number and value of live stock in the kingdom, as the careful consideration of evidence I have been able to obtain, permits. I have taken the utmost care to avoid exaggeration, and in this, at any rate, I have reason to think I have succeeded.
>
> When it is recollected that the Board of Agriculture returns are below, may be 10 per cent or even more below the correct figures; when it is recollected what a large proportion of the people in the country, farmers, dealers, shopkeepers, farm-laborers, working men of various kinds, and gentlemen's servants, make their living in one way or another by means of stock; when it is recollected what a very large number of valuable animals there are in this country, as shown by a sale of yearlings at Newmarket, the prices obtained at the dispersal of a herd of Shorthorns or a flock of Southdowns, the value of a successful horse on the turf, of a good hunter, polo pony, pair of carriage-horses or cart-horses, of a couple of pointers, a spaniel, a bull-dog or lap-dog, etc., when such facts are borne in mind I do not think there can be found justification for objection to the final figures I have arrived at on the score of excess; and yet they show a total sum of nearly £450,000,000 invested in live stock in this country.
>
> When to this is added the capital necessary to provide both buildings to house the stock, land on which to grow their food, barns, machinery, vehicles, harness and attendance, the total becomes so gigantic that I am surely justified in asserting: We have here an industry of enormous importance to the country, and one which merits far more attention than has ever yet been accorded to it.

[8] Heape, W., "The Breeding Industry," Cambridge, 1906.

Some Factors Which Make for Success in the Business of Breeding.

In the preceding section we have seen that the pecuniary rewards of success in the business of breeding animals are generous. But it also appears clearly from the statistics that the general average quality of the live stock on the farms of this country is deplorably low, and the returns to the breeder are correspondingly meager. What can be done to better this condition of affairs? Are there some obvious general principles which are being systematically neglected by the rank and file of the farmers? I believe that there are. Any farmer has it within his power to do certain things which will surely improve the quality of his stock, unless it is already of such high quality that further improvement is virtually impossible. And this last, we may be sure, is not a frequent condition of affairs. What then are some of these principles which we are neglecting?

THE TEST OF PROGENY PERFORMANCE AND ITS IMPLICATIONS.

For the practical breeder of any kind of animals one of the most significant results which has come from the modern scientific study of genetics is the demonstration of the importance of what I have elsewhere termed the principle of the progeny test in breeding for performance. This principle may be stated in the following way. *The only certain and sure test of the worth of an animal as a breeder is found in the actual performance of that animal's progeny.* The work of the last decade in genetics has led to a new conception of the mechanism of heredity which differs markedly from older views. The keynote to this conception is that it is the germ cell (egg or sperm) and not the body or soma which is the factor of primary importance in inheritance. What the individual is like in respect to its personal, somatic[9] characters is not determined by the

[9]For the reader not familiar with the technical terminology of biology, it may be said that " somatic " is used in designation of those characters of the organism which pertain to all parts except the reproductive or germ-cells. These reproductive cells are called " gametes." We then have the adjective " gametic," meaning " pertaining to the germ cells," in contrast to " somatic " meaning " pertaining to any or all parts of the organism other than the germ cells."

somatic characters of its parents, but by the composition or constitution of the parental gametes. Thus the size of a bean is determined not by the *size* of its parent bean, but by the gametic constitution of the latter.

In the principle above stated "performance" is used in the broadest and most inclusive sense. It may mean performance in the show ring, at the butcher's block, in the milk pail, at the shearing shed, in the trap nest, at the race track, in the pulling contest, etc. The essential point is that it is not possible to tell with any certainty by looking at a cow, for example, or its pedigree, whether the heifers from that cow will be good milkers. Nor does the fact that the cow herself is a superior milker ensure or prove that her heifers will be superior milkers. They may be or they may not. The only way to be sure about it is to *try them.* If they are good milkers then the use of that cow as a breeder is by just so much improving the quality of the herd. Again the fact that a bull's dam made a great record at the pail does not ensure that his daughters will be superior milkers. We can only know whether he possesses the ability to transmit dairy productivity by getting the actual records from some of his daughters. If these records are good the breeding worth of the bull is presumptively high. At any rate we know in that case that he is not lowering the average quality of the herd. Nothing else can furnish the sure and certain kind of information which the actual progeny test furnishes.

The principle of the progeny test carries with it a certain implication as to the age to which breeding stock should be retained. Obviously if we are to profit from our knowledge as to the breeding worth of a bull gained by the progeny test we must have the bull alive and in breeding condition *after* we have made the test. This means that we must keep him in the herd longer than bulls are usually kept by Maine breeders. If a herd bull is disposed of before any of his progeny have reached an age where their performance as milkers, for example, can be measured, then clearly this guiding principle of progeny test is playing no part in the breeding of the herd. Without this principle in active operation the breeder is in much the circumstances of a mariner without a compass. Progress towards

a desired goal is *possible,* but it is likely to be by a very roundabout and haphazard route, and is sure to be very slow.

It is a matter of considerable interest to examine statistically the age of breeding bulls in the hands of progressive Maine farmers and breeders. Data on this point are presented in Table IX. It should be noted particularly that all ages recorded in this table are the ages of the animals *at the time when they were bred successfully.* Each entry in the table is based upon what we call a " completed record." Such a completed record comprises, on the one hand, a service record, and on the other hand a birth record, which sets forth the facts regarding the calf born as a result of the service accounted for on the service record. The ages tabled here are the ages at the time of service.

The more important biometric constants from this table are shown in Table X.

TABLE IX.

Showing the Age in Years of Bulls Used as Breeders.

Age in years	Absolute frequency	Percentage
1	213	22.03
2	252	26.06
3	209	21.61
4	149	15.41
5	52	5.78
6	53	5.48
7	24	2.48
8	8	.83
9	3	.31
10	–	–
11	–	–
12	4	.41
13	–	–
14	–	–
15	–	–
16	–	–
17	–	–
18	–	–
Total	967	100.00

TABLE X.

Showing the Chief Physical Constants for Variation in Age of Breeding Bulls.

CONSTANT.	Bulls used as breeders.
Mean or average age	2.921± .037 years
Median age	2.589± .047 years
Third quartile age	3.844± .047 years
Standard deviation	1.722± .026 years
Coefficient of variation	58.94 ± 1.18%

From these tables we note that the average age of the herd bulls used to sire the 967 calves included in the statistics was just under three years. The median age of these herd bulls was approximately two and a half years. This means that one-half of the calves were sired by bulls *under* two and a half years old at time of service. Seventy-five per cent of all the calves (as shown by the third quartile age) were sired by herd bulls less than about three years and nine months old at time of service. Less than 15 per cent of the calves were sired by bulls five or more years old. Let us consider for a moment what these facts mean. A bull must be at least four years old before the breeder can possibly have had any opportunity to test adequately the milk producing capacity of his daughters. *But 85 per cent of all the calves covered in these statistics were sired by bulls under four years and 10 months of age.* In other words, in the breeding operations of a large number of Maine's most progressive and wide-awake breeders (for such the cooperators in this record scheme are) more than three-fourths of the calves produced in a given interval of time are sired by bulls about whose ability to transmit milking qualities absolutely nothing definite can by any possibility be known. It is doubtless entirely fair to assume that essentially the same conditions regarding cattle breeding methods obtain in other places generally. Is it remarkable that progress is so slow?

For comparison with these figures regarding Maine cattle in general let us examine the facts regarding the leading

cows in two of the leading dairy breeds, Jerseys and Holsteins. The facts regarding 32 of the leading cows of the Jersey breed are given in Table XI, which includes the name of the cow, the date when she was dropped, her sire's name, and the age of the sire at the time of conception of the daughter here dealt with. The ages of the sires are given to the nearest year.

TABLE XI.

Showing the Age of the Sires of some leading Jersey Cows at the Time of Service.

NAME OF COW.	Date dropped.	SIRE'S NAME.	Age at time of service.
Dosoris Park Lily 233783	Dec. 15, 1908	Dosoris Park Golden Lad 76986	2
Passport 219742	Nov. 26, 1906	Interested Prince 58224	6
Beaudesert's Lass 211380	Nov. 4, 1907	Rearguard 70962	2
Lass 83d of H. F. 289023	May 26, 1911	H. F. Torono 60326	11
Golden Angela 225625	May 7, 1907	Golden Lad of Berlin 75310	2
Raleigh's Financial Hope 279450	Oct. 24, 1912	Queen's Raleigh 88232	2
Golden Maid's Rose of St. John 288003	May 16, 1907	Imp. Golden Maid's Prince 93538	7
Lily Martin Figgis 209529	Feb. 13, 1906	Marna's Figgis Tormentor 69086	2
Jacoba's Loretta 251186	May 22, 1909	Irene's King Pogis 73182	3
Figgis 97th of H. F. 273502	July 22, 1910	H. F. Pogis 9th 55552	11
Karnak's Fontaine 250450	Dec. 1, 1910	Karnak's Noble 87952	2
Spermfield Owl's Vietor Lass 238138	Dec. 20, 1909	Spermfield Owl 57088	10
Lass 73d of H. F. 277540	Mar. 14, 1911	H. F. Torono 60236	10
Lass 92d of H. F. 302072	Feb. 5, 1912	H. F. Torono 60236	11
Lass 89th of H. F. 300426	Nov. 3, 1911	H. F. Torono 60236	11
Lass 74th of H. F. 281203	Dec. 28, 1910	H. F. Torono 60236	10
Interested Jap's Rose 306053	Oct. 9, 1912	Meridale Int. Prince 86473	3
Eminent's Bess 209719	July 1, 1905	La Rilla's Eminent Lad 71770	2
Jacoba Irene 146443	April 3, 1898	King of Corfu 50110	1
Sophie 19th of H. F. 189748	Jan. 24, 1905	Fort Hill Farm Chief 62859	4
Spermfield Owl's Temisia215982	May 1, 1907	Spermfield Owl 57088	7
Spermfield Owl's Dawson192935	Aug. 25, 1904	Spermfield Owl 57088	5
Lass 45th of H. F. 233488	Dec. 2, 1907	H. F. Torono 60326	7
Lass 40th of H. F. 223642	Mar. 5, 1907	H. F. Torono 60326	7
Lass 47th of H. F. 240327	Mar. 23, 1908	H. F. Torono 60326	7
Lass 30th of H. F. 214511	Mar. 26, 1906	H. F. Torono 60326	5
Landseer's Pacific Pearl 205097	Aug. 2, 1905	Landseer's N. Exile 54626	7
Gertie of Glynllyn 2d 206903	Feb. 9, 1906	Rosaire's Golden Lad 64554	4
Pride of Hillerest 194087	Dec. 5, 1905	Mabel's Golden Sultan 70683	2
Mary of Golden Letta 240917	Jan. 19, 1909	Golden Lad of Greenwood 64956	6
Lass 38th of H. F. 223628	June 10, 1906	H. F Torono 60326	6
Pearly Exile of St. L. 205101	July 15, 1906	Landseer's N Exile 54626	8

Upon analysis of the figures in Table XI we see that in round numbers, only one (or 3 per cent) of these very high producing Jerseys was sired by a bull under 1½ years old at the time of service; 9 (or 28 per cent) were sired by bulls under 2½ years old at the time; 11 (or 35 per cent) were sired by bulls under 3½ years old. All the rest were sired by bulls 3½ or more years old. The contrast between

these figures and those given above for Maine cattle in general is sufficiently striking. This result does not mean at all that old bulls will necessarily get better or more productive heifers than young bulls. Evidence that this is not necessarily so is seen even in the present table in the cases of Jacoba Irene, whose sire was only one year old at the time of this service, and Eminent's Bess, whose sire was only two years old. What the result does mean is that *those Jersey breeders who are breeding world's record animals in the great majority of cases are producing those animals with tested sires,* which they know from actual previous experience are transmitting to their offspring high dairy qualities.

A graphic comparison of the facts as to age of sires of Maine cattle in general and of this group of high producing Jerseys is shown in Fig. 1. The cross-hatched areas above and below the four year line show in a striking way the proportionate number of offspring sired by old and young bulls in the two cases.

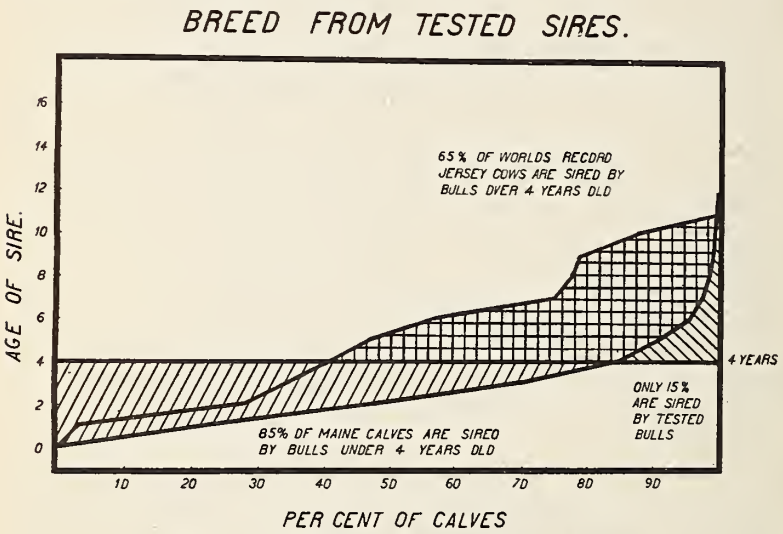

Fig. 1. For further explanation see text.

Similar data for Holsteins are given in Table XII. Here we have 25 cows of outstanding productive merit as evidenced by 12 month records. The arrangement of the table is the same as in the case of Table XI.

Table XII.

Showing the Age of the Sires of some leading Holstein Cows at the Time of Service.

Name of Cow.	Date dropped.	Sire's Name.	Age at time of service.
Banostine Belle De Kol 90441	Jan. 2, 1906	Friend Hengerveld De Kol Butter Boy 29303	4
Pontiac Clothilde De Kol 2d 69991	Dec. 26, 1903	Pontiac Korndyke 25982	4
High-lawn Hartog De Kol 84319	April 17, 1905	Friend Hengerveld De Kol Butter Boy 29303	3
Colantha 4th Johanna 48577	Oct. 30, 1898	Sir Johanna 23446	1
Daisy Grace De Kol 98228	Dec. 10, 1906	Friend Hengerveld De Kol Butter Boy 29303	5
Creamelle Vale 73357	Feb. 13, 1904	Paul De Kol Jr. 24762	5
Aralia De Kol 55194	June 26, 1900	Ignario De Kol 23538	2
Caroline Paul Parthenea 77784	Sept. 21, 1903	Aaggie Parthenea Bryonia29775	2
Belle Netherland Johanna 62304	Oct. 11, 1902	Johanna Rue 3d's Lad 26939	3
Woodcrest Meta Vernon De Kol 75866	Jan. 4, 1905	Prince Johanna De Kol 31168	2
Lunde Korndyke 75838	April 6, 1904	Korndyke Queen De Kol Prince 26025	4
Spotted Ann Daughter 100270	Oct. 23, 1906	Friend Hengerveld De Kol Butter Boy 29303	5
Riverside Sadie De Kol Burke 70708	Nov. 24, 1903	De Kol Burke 22991	7
Pontiac Artis 61114	July 11, 1902	Hengerveld De Kol 23102	5
Beauty of Plum 6th De Kol 2d 100889	Feb. 13, 1907	The Milk and Butter King 41114	1
Sadie Vale Pietertje 79740	Oct. 29, 1904	Onions De Kol Paul 31341	1
K. P. Lilith Clothilde 110228	Nov. 17, 1907	King of the Pontiacs 39037	2
Vale De Kol Elliston 87448	Sept. 26, 1905	Onions De Kol Paul 31341	2
Pauline Queen Johanna 89407	Dec. 14, 1905	Johanna de Pauline 2d's Lad 28301	4
K. P. Manor Kate 126416	Feb. 18, 1909	King of the Pontiacs 39037	3
Queen Juliana Dirkje 97608	Dec. 12, 1906	Juliana King of Riverside 38446	2
Maple Crest Pontiac De Kol Lady 100410	Feb. 14, 1907	Pontiac Aaggie Korndyke 38291	1
Spotted Lizzie 3d 91567	April 18, 1906	Johanna de Pauline 2d's Lad 28301	5
Alma Kuperus DeKol Pietertje 72609	Oct. 23, 1903	Duke De Kol Pietertje 29365	2
Pontiac Jewel 56976	July 24, 1901	Hengerveld De Kol 23102	4

The facts in regard to Holsteins, if somewhat less striking than those for Jerseys, are still widely different from the conditions found in the cattle breeding industry of Maine. Four (or 16 per cent) of these 25 leading producers of the Holstein breed were sired by bulls under 1½ years old at the time; 11 (or 44 per cent) were sired by bulls under 2½ years old; 14 (or 56 per cent) were sired by bulls under 3½ years old. All the rest (44 per cent of the total) were sired by bulls 3½ or more years of age at the time of service.

It is doubtful if there is any one thing, which every breeder could do if he would, likely to work greater improvement in the average quality of the live stock of the

state or nation than the faithful following of the policy of keeping every sire until it was definitely known, by the performance records of the first of his progeny, whether he was adding to or substracting from the productive value of the herd or flock. *Prove the breeding worth of the sire.* If it is poor discard him at once and get another. If it is good keep him as long as possible and by the multiplication of his desirable qualities in his offspring make definite and sure progress.

CONTINUITY OF PURPOSE IN BREEDING AND ITS IMPLICATIONS.

The art of breeding is at once a conservative and a progressive matter. It is conservative in the sense that it holds steadfastly to certain definite and relatively fixed ideals as to what the perfect animal should be. It is progressive in the sense that it bends every effort towards the attainment of those ideals. While it is, I think, unquestionable that these statements are true as general propositions it is unfortunately equally true that many breeders of animals exhibit in their practice rather striking exceptions to them. To the true breeder it is unbelievable, and indeed unthinkable, that there should be so many men as there are who breed without any definite ideals whatever before them. Again there are the so-called breeders whose ideals are perenially subject to change "without notice and without doubt." Today one type or one family is the greatest, indeed the only hope of the breed to one of these men. Meet him a year hence and you will discover, somewhat to your astonishment and confusion, that a totally different type, or wholly foreign blood lines, offer the only chance to stay the rapidly progressing annihilation of the breed. It is a misuse of words to call such persons breeders. They belong mentally in precisely the same category as the colored gentleman of the story who averred that he didn't know where he was going, but that he was on his way. Success in breeding is possible *only* for the man who does know where he is going, that is who has a definite, and for him permanent, ideal as to the kind of animals which he wants to breed. This ideal is something which must be always in his mind as he makes his

matings, or studies pedigrees, or buys stock to add to his herd or flock, or sells stock from it. Lacking such a definite ideal the breeder is worse off than the mariner without a compass, because he not only lacks a means of guidance but also he has no notion of what port he would like to arrive at if he could.

If he is to be successful the breeder must not only have an ideal but must also stick to it, and not change it every time he makes a mating. This implies that the breeding must fall within definite and rather narrow blood lines. It may fairly be said that some degree of narrow breeding (line breeding or inbreeding) is an essential for the highest success in breeding.[10]

This may seem a radical statement, but a careful study of the history of the best improved strains of live stock of all sorts leaves no room for doubt that the attainment of the highest degree of excellence has always been associated with the practice of a very considerable amount of inbreeding, of rather close degree. It is a curious paradox of animal husbandry in general that while, as a matter of fact, every successful breeder of high grade stock practices inbreeding to a greater or lesser extent, a great many of these men are violent, even fanatical, opponents to inbreeding in theory. Most of them will deny stoutly that they ever practice inbreeding. They contend that they practice "line breeding," but never, never "inbreeding."

The distinction here is obviously verbal and not biological, being in its essentials precisely similar to that between Tweedledum and Tweedledee.. What is called "line breeding" is simply a less intense form of narrow breeding than that which is called "inbreeding." The essential and important biological point is that what is actually done is to *purify* the stock in respect to all characters to as great a degree as possible. What the successful breeder aims to do is to get his stock into such condition that he has only one kind of "blood" in it. Expressed more precisely, though unfortunately more technically, it may be said that

[10]The following discussion of narrow breeding is based upon that contained in a paper entitled "The Biology of Poultry Keeping" by R. Pearl, published as Bulletin 214 of the Maine Agricultural Experiment Station, 1913.

the breeder endeavors to get his stock homozygous with reference to all important characters or qualities. The quickest way, indeed the only way, practically to obtain this result is by the practice of some degree of inbreeding. Sometimes a great stride towards the desired end may be made by mating brother and sister or parent and offspring together.

That a mating of such close relatives will surely result in disaster is one of the carefully nursed superstitions of breeding, which has often been exploded, but will doubtless always be with us. It may be said that all the evidence which may be gleaned from the experience of stock breeders indicates that the results which follow inbreeding depend entirely upon the nature of the individuals inbred. If one inbreeds weak animals, lacking in constitutional vigor, and carrying the determinants of undesirable qualities in their germ cells, the offspring resulting from such a mating will undoubtedly be more nearly worthless than were their parents. If, on the other hand, one inbreeds in the same way strong and vigorous animals, high in vitality, and carrying the germinal determiners of desirable qualities there may be expected a corresponding intensification of these qualities in the offspring. The time has come when a vigorous protest should be made against the indiscriminating condemnation of inbreeding. It should be clearly recognized that if the experience of stock breeders extending throughout the world, and as far back as trustworthy data are available, means anything at all it plainly indicates that some degree of narrow breeding is an *essential* to the attainment of the highest degree of success in the breeding of animals.

This contention receives full support from the results of modern exact studies in genetics. Such studies show that the personal bodily characters of the parents have no causal relation to the personal characters of the progeny. What the progeny shall be like is determined by the constitution of the germ cells of the parents. When by a proper system of selective breeding the point is reached where these germ cells are pure with reference to a particular character, or degree of a character, then that character will unfailingly appear in the offspring, in the degree of perfection in which

it is represented in the germ cells. This is the highest goal of the practical breeder. But in sexually reproducing organisms like the domestic animals purity of the germ cells with respect to the determiners of any character is only to be obtained, in the hands of a practical breeder without special scientific training, by the practice of inbreeding.

It should be clearly understood that indiscriminate inbreeding without definite purpose or reason is not advised or advocated. What we do mean is this: all successful breeding is the working out of carefully made plans looking toward the attainment of a definite ideal. In those plans narrow breeding has a place.

Introduction of new blood for purposes of rejuvenation or reinvigoration is, as ordinarily done, one of the surest ways to prevent any real or permanent improvement of stock by breeding. The difficulty here is that when one introduces new blood he runs the risk of introducing a whole set of characters *inferior* in their degree of perfection to what he already has in his own stock. As a matter of fact the average breeder is usually much too ready to introduce new blood. If one is breeding in certain definite blood lines and getting good results he should be exceedingly conservative about introducing any new blood, and should only do so when he has absolutely sure evidence that it is actually necessary for one reason or another.

There are two main reasons which induce the breeder to go out after new blood. The first is a fear of the evil consequences of inbreeding. This fear is usually, *in the particular case,* absolutely without foundation in fact. Yet how widely prevalent is the idea among the cattle breeders of Maine that at least as often as once in every three or four years one must go out and buy a new bull. It passes all comprehension that any intelligent person could expect to make steady progress in breeding on such a system.

Again the careful breeder sometimes finds himself in this situation. He has by well planned and executed breeding brought his stock up to a particular level of excellence. There the improvement stops. His animals breed true to that particular degree of quality but cannot be made to attain a higher degree. In other words, he has substantially purified his stock relative to the characters which

interest him. But he sees that the stock of some other breeder is measurably better than his. If A is to get his stock up to the B level he must introduce some B blood. This has long been the breeder's procedure, and if done in the right way, it is found to be as successful in practice, as it is justifiable in theory in the light of modern ideas respecting inheritance. The danger in the matter in such a case as this under discussion all turns on the way in which the thing is done. If one feels it to be desirable, for the reason specified, to introduce " new blood " let him by all means do it gradually, and not swamp the whole stock with the new germinal combinations all at once. For if he does he may destroy in this way at one blow results which have taken years of careful breeding to build up.

THE SUPERIORITY OF THE PUREBRED.

The necessary, intrinsic expense involved in breeding and rearing a purebred animal is no more than that involved in breeding and rearing a grade or a scrub. The end product is worth a great deal more in the former case than in the latter, on the average. These considerations being true, and I think they cannot be successfully controverted, it would seem to be the most obvious of sound business principles to keep and breed only purebred, registered livestock. Yet the proportionate number of farm animals which are purebred must be very small indeed.

The chief reason for the relatively small proportion of purebred animals is fairly evident. Most farmers keep animals solely for their immediately productive or useful qualities. They are in no true sense breeders and make no attempt to realize the additional profits which would accrue from combining a breeding business, on however small a scale, with a producing business. The farmer of the sort mentioned is prone to compare in his mind the productive qualities of the best of his grades with the poorest purebreds he has ever seen or knows about, to the detriment of purebred animals in general. He is then apt to take the general position that it would not pay to buy purebred animals for a foundation stock to breed from.

The argument on which this extremely prevalent point of view is based is essentially a fallacious one, because it

overlooks certain very pertinent considerations. In the first place while it is true that the best grades are much better than the poorest purebreds in productive qualities, and indeed may in some cases rank with the best, it is also true that the general *average* productivity of purebred animals is higher than that of non-purebreds.

In the second place there can be no comparison between purebred animals and non-purebred animals, considered as groups or on the average, in regard to extent to which they transmit good qualities to their offspring. The purebred animal is, on the average, narrow-bred or line-bred to a much greater extent than the grade or scrub. This means that the likelihood of any particular individual transmitting good qualities which it may possess to its progeny is by so much enhanced.

In the third place, the breeder of purebred animals is not depending, as is the breeder of grades, solely on their productive qualities as a source of income. If he is handling purebreds the offspring are a standard commodity to which a more or less definite rating as to value attaches automatically. If he is breeding scrubs or grades the offspring are apt to be more or less troublesome and unprofitable by-products of his manufacturing business. The dairyman for example who keeps only grade cows has no market whatever for his bull calves except as meat. When sold for this purpose he is sure to get small returns for them. On the other hand, the dairyman whose herd is made up of purebred animals at once has opened out before him the possibility of an additional and better market for his bull calves. He can sell them for breeding purposes and in this way realize much more than meat prices for them.

Finally, the breeder of purebred, registered live stock at once identifies himself with a large and powerful organization, namely that of the registered live stock interests of the country. The extent of these interests is indicated in Table XIII which is based upon a table published by Dinsmore.[11]

[11]Dinsmore, W. "The registration of pedigrees." Breeders' Gazette, Vol. LXX, p. 881-882, 1916.

Table XIII.

Data regarding the Magnitude of the Purebred Livestock Interests.

Cattle.	End of fiscal ear.	Number of members.	Number of breeders recording.	New members during last year.	Number of registrations last year.	Number transfers last year.
American Shorthorn Breeders' Association	Oct. 31, 1915	800	18,000	.....	65,000	7,709
American Hereford Cattle Breeders' Association	Sept. 1, 1915	6,700	14,000	625	45,000	32,000
American Aberdeen-Angus Breeders' Association	Oct. 31, 1915	3,100	10,000	287	16,274	14,092
American Galloway Breeders' Association	Oct. 31, 1915	410	1,000	12	1,150	610
Red Polled Cattle Club of America	Nov. 20, 1915	1,000	1,800	81	3,628	1,669
Polled Durham Breeders' Association	Nov. 25, 1915	312	2,500	.....	2,267	.....
American Guernsey Cattle Club	April 30, 1915	472	5,000	52	11,114	9,036
Holstein-Friesian Association of America	April 30, 1915	7,676	23,000	1,345	67,680	66,776
American Jersey Cattle Club	Mar. 31, 1915	554	23,000	43	33,006	30,874
Ayrshire Breeders' Association	Dec. 31, 1915	776	.....	106	3,600	3,180
American Polled Hereford Breeders' Association	Nov. 30, 1915	506	1,750	106	1,737	973
Horses.						
Percheron Society of America	Oct. 31, 1915	7,336	17,000	916	8,492	6,831
American Clydesdale Association	Nov. 30, 1915	840	.....	150	1,000	950
American Association of Importers and Breeders of Belgian Draft Horses	Nov. 11, 1915	925	.....	150	1,128	1,420
American Shire Horse Breeders' Association	Nov. 25, 1915	910	410	54	632	478
National French Draft Horse Association	Oct. 17, 1915	240	.....	.....	1,213	574
American Suffolk Horse Association	Nov. 30, 1915	63	121	8	72	38
American Saddle Horse Breeders' Association	April 9, 1915	303	1,800	.....	1,475	300
American Shetland Pony Club	Oct. 31, 1915	486	250	30	1,109	800

CATTLE.	End of fiscal year.	Number of members.	Number of breeders recording.	New members during last year.	Number of registrations last year.	Number transfers last year.
SHEEP.						
American Shropshire Registry Association	Sept. 30, 1915	4,715	3,500	143	15,572	3,858
American Southdown Breeders' Association	Oct. 30, 1915	357	2,500	12	2,432	1,750
American Rambouillet Sheep Breeders' Association	Jan. 3, 1916	451	650	9	6,000	1,548
American Oxford Down Association	Nov. 30, 1915	504	2,000	16	3,169	700
American Cotswold Association	Dec. 31, 1915	240	350	.....	.....	.....
American Cheviot Sheep Society	Jan. 1, 1916	196	200	11	612	276
Continental Dorset Club	Dec. 1, 1915	183	200	17	1,215	787
American Hampshire Sheep Association	Nov. 24, 1915	851	1,250	54	10,415	2,916
National Lincoln Sheep Breeders' Association	Nov. 30, 1915	109	122	14	1,650	128
Standard Delaine Merino Sheep Association	Jan. 5, 1915	25	25	.....	112	2
SWINE.						
American Berkshire Association	Oct. 30, 1915	642	15,000	192	14,940	14,118
American Poland-China Association	Oct. 31, 1915	2,035	11,700	76	25,350	.....
American Yorkshire Club	Nov. 30, 1915	336	800	14	1,808	175
National Poland-China Record Association	Jan. 31, 1915	885	1,200	36	5,000	500
Standard Poland-China Record Association	Dec. 22, 1915	1,232	10,000	93	22,675	1,000
National Mule-Foot Hog Record Association	Dec. 31, 1915	130	5,000	10	1,462	745
National Duroc-Jersey Record Association	Nov. 30, 1915	5,468	10,000	605	35,693	7,000
American Duroc-Jersey Swine Breeders' Association	Nov. 15, 1915	1,700	8,950	287	17,100	17,060
Totals		53,468	193,078	5,554	430,782	230,873

From this table it appears that the number of purebred registered animals in this country is increasing at the rate of nearly a half million a year. Nearly 200,000 breeders of such purebred live stock are recording their animals at the present time. All of these interests are united in the National Society of Record Associations. The purposes of this Society are stated in its constitution as follows:

" To advance the interests of all registry associations by devising and perfecting practical methods of preserving pedigrees of purebred animals; by united effort endeavoring to secure the enactment of equitable laws relating to record associations; by securing the adoption of just rates by the railroads on exhibition and breeding stocks, and also to do and transact such other business as will, in the judgment of such society, advance the interest of breeders of purebred stock through their respective registry associations."

Regarding the results which have been obtained by this National Society of Record Associations, and the significance of the Society for the breeder, the following statement by the Secretary, Wayne Dinsmore,[12] is of interest:

[12]Dinsmore, W. Loc. cit. p. 882.

" In the five years that have elapsed the various associations, working through the National society, have defeated some hostile legislation, aided in shaping some that was favorable and given wider publicity to the work which the individual associations are trying to accomplish. They also took up existing abuses in the shipment of breeding animals in less than carload lots (L. C. L. shipments), and, after the failure of negotiations to secure proper concessions from the railroads, carried the case to the Interstate Commerce Commission."

The breeder of grade animals stands in a business way practically by himself. The breeder of purebred animals automatically becomes allied with an extensive and powerful organization. There can be no doubt from a strictly business point of view that in this regard alone the man with the purebreds enjoys an enormous advantage over the man who keeps only non-purebred, grade or scrub, animals.

Conclusion.

In this paper I have tried to show, first, the importance of the live stock breeding industry as a business, and second, how the neglect of some rather obvious and easily remedied matters holds back the more successful development of that business in many particular cases. One must not, however, hastily draw the conclusion that if he attends strictly to the things which are pointed out in this paper as being commonly neglected, he will surely attain success in the breeding business. There are many more factors involved in the case than have been discussed here. Perhaps the most fundamental of all is the man himself. By no means everyone can become a successful breeder of live stock. The art of breeding demands personal qualifications which are rather rare. Bates, the great Shorthorn breeder, once said: "Hundreds of men may be found to make a Prime Minister for one fit to judge the real merits of Shorthorns." The man who is to be a real breeder and a successful one must start with a love for animals and a natural instinct for handling them. Without these qualifications he can never be a breeder in the highest sense of the word. Furthermore, the real breeder is always a student, with the instincts of the scientific investigator. He studies his animals and their pedigrees till he knows them thoroughly. He studies the pedigrees of all the leading animals in his breed. He attends live stock shows, fairs, and sales that he may study the best individuals of the breed.

Besides all these things the successful breeder must know how to feed, care for, and develop his animals properly. The most excellent individual may be ruined by improper care. So then along with knowledge and skill in the art of feeding must go an expert ability to recognize condition in an animal, to detect and correct the slightest impairment of health and vigor.

Altogether the real breeder must combine many and varied abilities with his natural love for good animals. And what is the reward? To the *real* breeder it is great and manifold. He will have the satisfaction and emoluments of a creator of something new and needed. The

world will always need better animals and be prepared to pay for them. How well it will pay, everyone who reads live-stock journals knows. Prices for breeding animals numbered in five figures are of such frequent occurrence as to excite only passing comment. Furthermore the joy of creating these new and better animal types is the breeder's. In some degree he may justifiably feel that he is guiding the forces of nature to the working out of an ideal, which is his.